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| STATE OF MISSOURI<br>MICHAEL D. HARMS<br>NUMBER PE–26651<br>PROFESSIONAL ENGINEER<br>THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY. | **MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION**<br>105 W. CAPITOL AVE.<br>JEFFERSON CITY, MO 65101<br>Phone (888) 275-6636 |
| | If a seal is present on this sheet, JSP's has been electronically sealed and dated. |
| | JOB NO. K16C9370<br>Jackson County, MO<br>Date Prepared: 5/12/2016 |
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## A. CONSTRUCTION REQUIREMENTS

**1.0 Description.** This provision contains general construction requirements for this project.

**2.0 Construction Requirements.** Plans for the existing structure are included in the contract in the bridge electronic deliverables zip file for informational purposes only.

**2.1** In order to assure the least traffic interference, the work shall be scheduled so that any lane closure is for the absolute minimum amount of time required to complete the work. A lane shall not be closed until material is available for continuous construction and the contractor is prepared to diligently pursue the work until the closed lane is opened to traffic.

**2.2** Qualified special mortar shall be a qualified rapid set concrete patching material in accordance with Sec 704. A qualified rapid set concrete patching material will not be permitted for repairing concrete deck (half-soling), deck repair with void tube replacement, full depth repair, modified deck repair and substructure repair (formed) unless a note on the bridge plans specifies that a qualified special mortar may be used.

**2.3** Provisions shall be made to prevent any debris and materials from falling onto the roadway. Any debris and materials that falls below the bridge outside the limits mentioned previously and if determined necessary by the engineer, the debris shall be removed as approved by the engineer at the contractor's expense. Traffic under the bridge shall be maintained in accordance with the contract documents.

**2.4** Any damage sustained to the remaining structure as a result of the contractor's operations shall be repaired or the material replaced as approved by the engineer at the contractor's expense.

**2.5** Provisions shall be made to prevent damage to any existing utilities. Any damage sustained to the utilities as a result of the contractor's operations shall be the responsibility of the contractor. All costs of repair and disruption of service shall be as determined by the utility owners and as approved by the engineer.

**3.0 Method of Measurement.** No measurement will be made.

**4.0 Basis of Payment.** Payment for the above described work will be considered completely covered by the contract unit price for other items included in the contract.

## B. EPOXY PRESSURE INJECTING

**1.0 Description.** Collision damage cracks in the intermediate bent column shall be pressure injected with epoxy. The engineer will designate the cracks to be repaired.

**2.0 Material.**

**2.1 Epoxy.** The epoxy material shall consist of a two-component system in accordance with the requirements of ASTM C 881, Type IV, Grade 1, except that the viscosity shall be a maximum of 4.5 poise (0.45 Pa·s). The Class designation of the epoxy shall be determined according to the temperature that exists on the job.

**2.2 Certification.** The contractor shall furnish manufacturer's certification that the material supplied is in accordance with these specifications. The certification shall include or have attached typical test results for all specified properties required by ASTM C 881 for the injecting resin. The engineer reserves the right to sample and test any or all material supplied.

**3.0 Construction Requirements.** The surface to receive the epoxy grout shall be cleaned of laitance, grease and foreign matter by sandblasting. The cracks shall be cleaned of debris by using oil-free and water-free compressed air or vacuum. After the cracks are cleaned, the epoxy shall be injected in accordance with manufacturer's recommendations. The temporary surface seal and placement and method of attachment of injection ports shall be in accordance with the epoxy manufacturer's recommendations.

**4.0 Method of Measurement.** The extent of epoxy pressure injecting may vary from the estimated quantity but the contract unit price shall prevail regardless of the variation. The epoxy pressure injecting will be measured to the nearest linear foot.

**5.0 Basis of Payment.** Accepted quantity of epoxy pressure injecting will be paid for at the contract unit price. Payment for the above described work, including all material, equipment, labor and any other incidental work necessary to complete this item, will be considered completely covered by the contract unit price for "Epoxy Pressure Injecting".

C. RAPID SET CONCRETE PATCHING MATERIAL – VERTICAL AND OVERHEAD REPAIRS

**1.0 Description.** This specification covers cementitious concrete, polymer-modified concrete and polymer concrete that are suitable for repairing concrete surfaces on bridges or concrete structures, particularly under fast setting or special conditions. The repairs would involve vertical or overhead applications. The work shall consist of removing, furnishing, preparing, and placing materials at locations as shown on the plans or as directed by the engineer.

**2.0 Material.** All materials shall be in accordance with MoDOT specifications and as noted herein.

**2.1 Aggregate For Extending Commercial Mixture.** Coarse and fine aggregates shall be in accordance with Sec 1005, except the requirements for gradation and percent passing the No. 200 sieve shall not apply. Coarse aggregate meeting Gradation E requirements shall be used for repairs greater than one inch (25 mm) in depth. Fine aggregate will be allowed for repairs less than one inch (25 mm). Aggregate specified, bagged, labeled and furnished by the rapid set concrete patching material manufacturer may also be used for mortar extension.

**2.2 Material Applications**. The contractor shall select and use the product most suitable for the work and field conditions in accordance with these specifications.

**2.3 Curing.** Rapid set concrete patching material shall be cured until the minimum compressive strength 1500 psi is attained using standard curing specifications, unless otherwise specified by the manufacturer.

**2.4 Qualification and Project Acceptance.**

**2.4.1 Inspection.** All materials shall be subject to inspection and sampling by MoDOT at the source of manufacture, intermediate shipping terminal or destination. MoDOT will be allowed free access to all facilities and records as required to conduct inspection and sampling.

**2.4.2 Qualification.** Prior to use, rapid set concrete patching materials need to be qualified.

**2.4.2.1 Requested Information.** The manufacturer shall submit with samples of the materials, a written request to Construction and Materials with the following information:

(a) New Products Evaluation Form

(b) Brand name of the product.

(c) Certification that the material meets this specification.

(d) Certified test results from an independent laboratory showing compliance with this specification.

(e) Specific preparation instructions of repair area.

(f) Specific mixing, handling and curing instructions.

(g) Application type (i.e., vertical or overhead).

**2.4.2.2 Field Evaluation.** Final approval will be granted when the following requirements are met:

(a) MoDOT report documenting two years of field performance on MoDOT system. The report will contain the placement date, field observations (semi annual), description of field performance and photographs of in-place material.

(b) A manufacturer's representative shall be present during placement of the material to provide technical expertise.

**2.4.2.2.3 Disqualification.** If during the two year observation period the repair area(s) fails the product will not be added to the qualified list.

**2.5 Qualified List.** The listing of qualified products are available from Construction and Materials or on MoDOT's web site. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed. The material will be subject to removal from the qualified list if there is evidence of unsatisfactory performance or a change in manufacturing process or formulation, or when random sampling and testing of material offered for use indicates nonconformity with any of the requirements herein specified.

**2.6 Certification.** The contractor shall supply a manufacturer's certification to the engineer for each lot of material furnished. The certification shall include the name of the manufacturer, a manufacturer certification statement that the material supplied is the same as that qualified and listing the date of qualification.

**2.7 Acceptance.** Acceptance of the material will be based on the use of a qualified product, the manufacturer's certification that the material supplied is the same as that approved and upon the results of such tests as may be performed by the engineer.

**3.0 Mixture.** Unless otherwise specified, rapid set concrete patching material shall be approved commercial mixtures meeting Sections 3.1 – 3.1.3.. Rapid set concrete patching materials shall be specifically designed for the application needed.

**3.1 Commercial Mixtures**. Rapid set concrete patching material in its sacked form and mixtures when properly prepared in accordance with the manufacturer's specifications, shall meet the minimum test requirements given in Table 1. Mixtures may be supplied, as required, as a patching mortar or as a patching mortar with aggregate extension. If the material is to be supplied with extender aggregate, this shall also pass the required tests in Table 1 using the maximum allowed amount of extender aggregate.

**3.1.1 Mixture Requirements.** Rapid set concrete patching material shall be single packaged dry mix requiring the addition of water or other liquid component just prior to mixing. The material shall not contain soluble chlorides as an ingredient of manufacture. The material shall be placed in accordance to the manufacturer's recommendations.

**Table 1**
**(English Unit)**

| Physical Test Property | Specification | Requirement for cementitious concrete | Requirement for polymer-modified concrete | Requirement for polymer concrete |
|---|---|---|---|---|
| Bond Strength by Slant Shear | ASTM C882/C928 [2] | min. 1000 psi @ 24hrs.& min. 1500 psi @ 7 days | n/a | min. 1000 psi @ 24hrs.& min. 1500 psi @ 7 days |
| Linear Coefficient of Thermal Expansion [1] (for bagged mortar only, without extension aggregate) | ASTM C531 | n/a | n/a | 4 – 8 X 10-6 in/in/deg F |
| Resistance to Rapid Freezing & Thawing | AASHTO T161 or ASTM C666 | 80% min. using Procedure B[3] (300 Cycles) | 80% min. using Procedure B[3] (300 Cycles) | n/a |
| Compressive Strength | AASHTO T22 or ASTM C39 | 1500 psi @ 3 hr & 3000 psi @ 24 hr | 1500 psi @ 3 hr & 3000 psi @ 24 hr | n/a |
| Rapid Chloride Permeability | AASHTO T277 or ASTM C1202 | 1000 coulombs @ 28 days | 1000 coulombs @ 28 days | 1000 coulombs @ 28 days |
| Length Change | AASHTO T 160 or ASTM C157 | In water Storage (+0.15) In air storage (-0.15) | In water storage (+0.15) In air storage (-0.15) | n/a |
| Color | | gray | gray | gray |

[1] Not required for extended mixtures if the mortar passes this requirement.

[2] ASTM C882 shall be performed on non-water based materials. ASTM C928 shall be performed on water-based materials.
[3] Procedure A may be used in lieu of Procedure B

**3.1.2 Construction Requirements.** The manufacturer shall provide with the bagged mixture, specifications for the mixing procedure, amount and kind of liquid to be added, and the amount of aggregate extension allowed, if any. All mixing, handling and curing practices recommended by the manufacturer shall be followed and will be considered a part of these specifications.

**3.1.3 Removal from Qualified List.** All mixtures shall be approved before use. Reoccurring failures of any mixture for any reason will be cause for removal from the qualified list.

**3.2 Vertical Repair..** A qualified rapid set concrete patching material approved for vertical use may be used when specified on the plans and as approved by the engineer. The engineer will make field cylinders to verify the 1500 psi (10 MPa) minimum strength. The material shall adhere to the concrete surface without sagging.

**3.3 Overhead Repair.** A qualified rapid set concrete patching material approved for overhead use may be used when specified on the plans and as approved by the engineer. The material shall be placeable in layers of at least 1 inch on overhead applications without the use of formwork or anchoring devices. The material shall adhere to the concrete surface without sagging. The engineer will make field cylinders to verify the 1500 psi (10 MPa) minimum strength.

**4.0 Construction Requirements.**

**4.1 Mixing.** Rapid set concrete patching material shall be mixed and finished according to the manufacturer's recommendation.

**4.2 Preparation of Repair Area.** Deteriorated, damaged or defective concrete as shown on the plans, required by the specifications or as directed by the engineer, shall be removed. All exposed reinforcement shall be thoroughly cleaned as shown on the plans, required by the specifications or as directed by the engineer. Unless otherwise specified by the commercial mixture manufacturer, the existing surface shall be damp and all free water shall be removed prior to placement of the required material.

**4.3 Bonding Agent.** A bonding agent may be used if recommended by the rapid set concrete patching material manufacturer.

**5.0 Method of Measurement.** No measurement will be made for rapid set concrete patching material.

**6.0 Basis of Payment.** Rapid set concrete patching material will be paid for at the contract unit price for Substructure Repair (Unformed) and will be considered full compensation for all labor, equipment and material to complete the described work.

D. FIBER WRAP

**1.0 Description.** This work shall consists of designing, furnishing and placing fiber reinforced polymer (FRP) composite wrap for concrete column confinement at intermediate bent no. 4 of Bridge A2446 as shown on bridge plans and as directed by the engineer. The fiber wrap, at a

minimum, shall provide for strength equivalent to the confinement provided by the existing confinement steel.

**2.0 Materials.** The storage and handling of materials for the FRP composite work shall be in accordance with the manufacturer's written recommendations in factory sealed containers with the FRP manufacture's labels. Labels shall be intact and legible with date of manufacture and shelf life.

**Companies for FRP Fiber Wrap systems approved for use on this repair include:**

QuakeWrap, Inc.
2055 E. 17th Street
Tucson, AZ 85719
U.S.A.
Phone: (520) 791-7000
Fax: (520) 791-0600
Toll Free: 1-866-QuakeWrap [782-5397]

Fyfe Co. LLC or Fibrwrap, an Aegion company

Headquaters:
1400 E Orangethorpe Ave
Fullerton, CA 92831
Tel: 714.278.1900
Fax: 714.278.1911

Midwest Office:
Chicago, IL
Tel: 571.296.4326
Fax: 708.478.4871

CSRI, Inc.
11030 N. 21st Avenue
Phoenix, AZ 85029
Phone: 602-678-0851
Toll-free 877-207-CRSI
Fax: 602-678-0821
Email:info@crsi-inc.com

CDC Restoration & Construction, L.C.
130 E. Gordon Lane
Salt Lake City, UT 84107
Office: (801) 261-8525
Fax: (801) 266-6645
Mail to: sales@cdcrestoration.com

Other systems/companies may be submitted for approval by the Engineer.

**2.1 Material Properties.**

**2.1.1** The contractor shall provide a unidirectional, high-strength fiber fabric fully saturated with compatible epoxy resin per manufacturer's recommendations. FRP provided shall meet or exceed ASTM D3039 test procedure requirements (tensile modulus, stress and strain) as determined from independent laboratory testing.

**2.1.2** The contractor shall provide a flexible, waterproofing, non-vapor barrier protective top coating compatible with the FRP manufacturer's recommendations to protect the FRP from

ultraviolet radiation and heavy abrasion. The protective top coating shall be concrete gray in color and match the color of the adjacent unwrapped concrete.

**2.2 Product Data.** Manufacturer's product data including physical and chemical characteristics, material specifications for each component, limitations on use of the system, construction or application specifications, maintenance instructions and general manufacturer's recommendations regarding each system shall be provided. Product data on the proposed primer, putty, resin, saturant, and carbon fiber shall be included. Testing information on the combination of the proposed carbon fiber reinforcement and epoxy when used together as a system shall be provided. The contractor shall provide certifications by the producers of the materials that all materials supplied are in accordance with all the requirements and standards of the appropriate ASTM and other agencies. Manufacturer's Material Safety Data Sheets (MSDS) for all materials to be used shall be provided.

**2.2 Contractor Submittals.** Submit the following documentation and obtain approval 3 weeks before work commences:

**2.2.1 Contractor Qualifications.** The contractor shall provide a manufacturer's certification of technical training, FRP system selected, project supervisor, and documentation showing the contractor has been certified or approved by the manufacturer of the FRP system. A contractor specializing in the supply and installation of FRP repair systems with minimum of 5 years of experience in performing FRP composite retrofits shall perform the work. A trained project supervisor shall remain at the work site at all times to instruct the work crew in the FRP application procedures.

**2.2.2 Shop Drawings.** Shop drawings shall be submitted signed and sealed by a Missouri Professional Engineer in accordance with Sec 107 for "Authentication of Certain Documents". Shop drawings shall include the detail of types, locations, dimensions, number of layers and splice details and orientation of all FRP materials and coatings to be installed. The wrap shall completely enclose the column with a minimum lap of wrap as recommended by the FRP manufacturer.

**2.2.3 Calculations.** Signed and sealed calculations indicating that the proposed system provides an equivalent or better confinement capacity than the original confinement reinforcement provided for the column shall be submitted by a Missouri Professional Engineer in accordance with Sec 107 for "Authentication of Certain Documents".

**3.0 Construction Requirements.** FRP shall be required for concrete columns as noted on the plans and as directed by the engineer.

**3.1 Drainage Requirement.** The surfaces of the concrete column to receive the FRP composite shall be reasonably dry in the judgment of the engineer and as recommended by the FRP manufacturer.

**3.2 Surface Preparation for Columns (Contact-Critical).**

**3.2.1** The concrete surfaces to receive the FRP composite shall be free from fins, sharp edges and protrusions that may cause voids or depressions behind the installed FRP composite or that, in the opinion of the FRP installer and as directed by the engineer, will damage the fibers. Existing uneven surfaces to receive FRP composite, including voids or depressions shall be filled with compatible epoxy filler. The contact surfaces shall have no free moisture on them at

the time of application. If moisture is present, FRP manufacturer written recommendation shall be followed for when moisture is present.

**3.2.2** All damaged or unsound concrete, spalls and loose material, dirt and debris shall be removed. Irregular surfaces and voids shall be filled with thickened epoxy to eliminate air surface voids. Paint and concrete that is well adhered are not required to be removed. Round off sharp and chamfered corners to a minimum radius of 3/4 inch shall be performed by means of forming with the system's thickened epoxy. Variations in the radius along the vertical edge shall not exceed 1/2 inch for each foot of column height.

**3.3 Installation of FRP.** The FRP shall be installed in accordance with the manufacturer's written recommendations.

**4.0 Method of Measurement.** This work will be completed on a per square foot basis.

**5.0 Basis of Payment.** The contractor is responsible for visiting the site and appropriately familiarizing themselves with the work to bid the repair items outlined in this provision. Payment for the above described work, including all material, equipment, labor and any other incidental work necessary, will be considered completely covered under the contract unit price for Fiber Wrap.